Multi-Platform Forward Looking Infrared Integrated Subsystems:

A 21st Century Test & Evaluation Process

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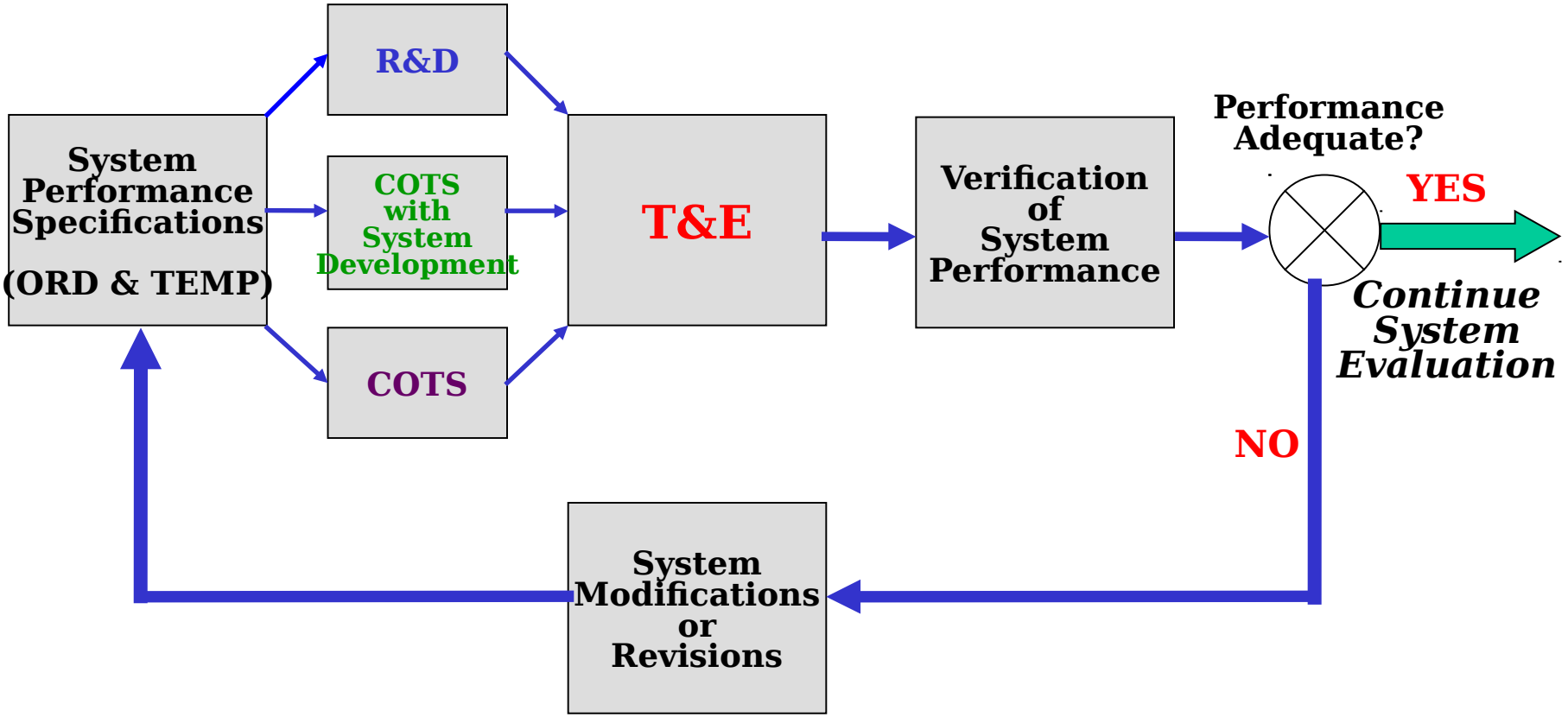
NAVAL AVIATION TECHNOLOGIES

Outline

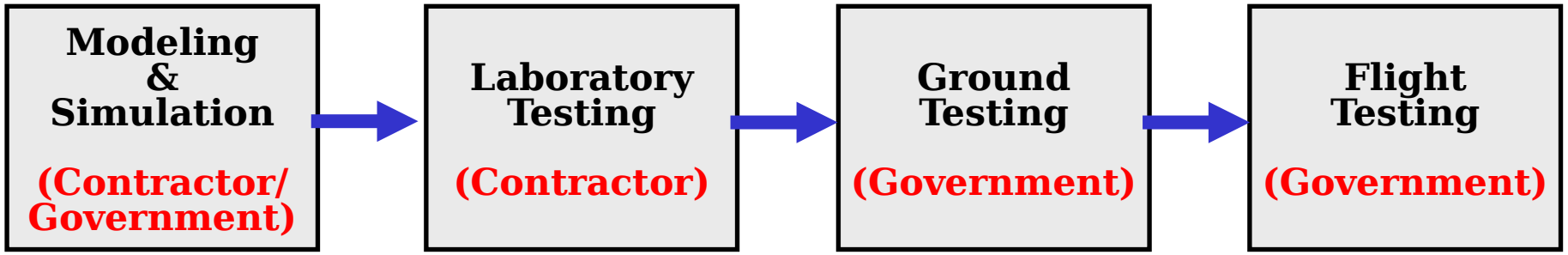
- T&E in the System Development Cycle
- T&E Stages
- Design Considerations and Tradeoffs
- Subsystem Testing Requirements
- Modeling and Simulation
- System Integration and Enhancements
- Future Testing Considerations
- EOTT / IMISTS
- Conclusions
- Questions

T&E in the System Development Cycle



T&E is vital to the Systems Engineering and Systems Development Process

T&E Stages


Modeling & Simulation
(Contractor/ Government)
Laboratory Testing
(Contractor)
Ground Testing
(Government)
Flight Testing
(Government)

Design Considerations - FLIR

- **R&D**
  - *wavelength range of interest (e.g. 3-5μm, 8-12μm)*
  - *detector array resolution (e.g. 640x480 pixels undithe*
  - *sensitivity vs. system resolution*
- **COTS w/System Development**
  - *requires number and type of FOV's*
  - *zoom capability*
- **COTS**
  - *required system resolution with FOV determined*
  - *pod vs. turret*
  - *systems integration issues*

System Design Tradeoffs - FLIR

- **Pod vs. Turret**
  - aircraft type
  - mission requirements
  - available space, weight, and power limitations

- **Aperture Size vs. FOV and Resolution**
  - ↑ aperture ↔ ↑ resolution and ↑ FOV
  - ↑ aperture ↔ ↑ size and ↑ cost

- **Sensitivity vs. Resolution**
  - ↑ sensitivity w.r.t ↓ resolution
  - ↓ sensitivity w.r.t ↑ resolution

- **3-5μm vs. 8-12μm**
  - 3-5μm has better resolution; better in haze and fog

Design Considerations - Camera

- **R&D**
  - *required operational light level (daytime vs. dusk)*
  - *detector array resolution (e.g. 560x490 pixels)*
  - *image processing capability needed*
  - *operational range and image quality requirements*
- **COTS w/System Development**
  - *contrast requirements*
  - *required FOV's*
  - *magnification capability*
- **COTS**
  - *required system contrast with FOV determined*
  - *pod vs. turret*

System Design Tradeoffs - Camera

- **Pod vs. Turret**
  - aircraft type
  - mission requirements
  - available space, weight, and power limitations

- **Aperture Size vs. FOV and Resolution**
  - ↑ aperture ↔ ↑ resolution and ↑ FOV
  - ↑ aperture ↔ ↑ size and ↑ cost

- **Daylight vs. Dusk (low-light levels)**

- **Light Intensity vs. Resolution vs. Contrast**
  - fixed contrast → ↑ resolution as ↑ light intensity

Design Considerations - Laser

- **R&D**
  - *desired laser wavelength (e.g. 1.064μm, 1.57μm)*
  - *desired energy per pulse (e.g. 25-250mJ/pulse)*
  - *beam divergence requirements*
- **COTS w/System Development**
  - *laser designator and/or rangefinder required*
  - *programmable PRF capability*
  - *laser spot tracker (LST) and/or laser marker requirement*
- **COTS**
  - *system reliability in operational environment*
  - *pod vs. turret*
  - *system integration*

System Design Tradeoffs - Laser

- **Pod vs. Turret**
  - aircraft type
  - mission requirements
  - available space, weight, and power limitations

- **Beam divergence vs. effective energy on target**
  - ↑ divergence ↔ ↓ energy on target
  - ↓ divergence ↔ ↑ energy on target

- **Increased capability vs. system cost and design complexity**

- **Laser pointing accuracy vs. optical stabilization hardware**

Subsystem Testing Requirements

Ground Testing

- equipment capable of testing system performance
- trained personnel
- adequate system integration
- consideration of local testing environment

Flight Testing

- selection of target board
- trained aircrew
- proper system integration
- consideration of environmental effects

Modeling and Simulation

Motivations for using Modeling and Simulation

- used prior to testing to predict system performance
- used in conjunction with testing
- may reduce certain testing requirements
- may conserve program funds
- NOT a substitute for valid T&E data

Usefulness to Flight Testing Applications

- modeling of atmosphere
- replace radiosonde temperature and RH data
- post-test comparison of data with model results

System Integration and Enhancements

T&E enables system integration and performance enhancements through the following methods…

(1) Confirmation of performance specifications compliance

(2) Redirection of government testing towards further contractor testing

(3) Government testing of Contractor assets prior to platform integration

(4) Anticipated “cumulative system degradation”

Future Testing Considerations

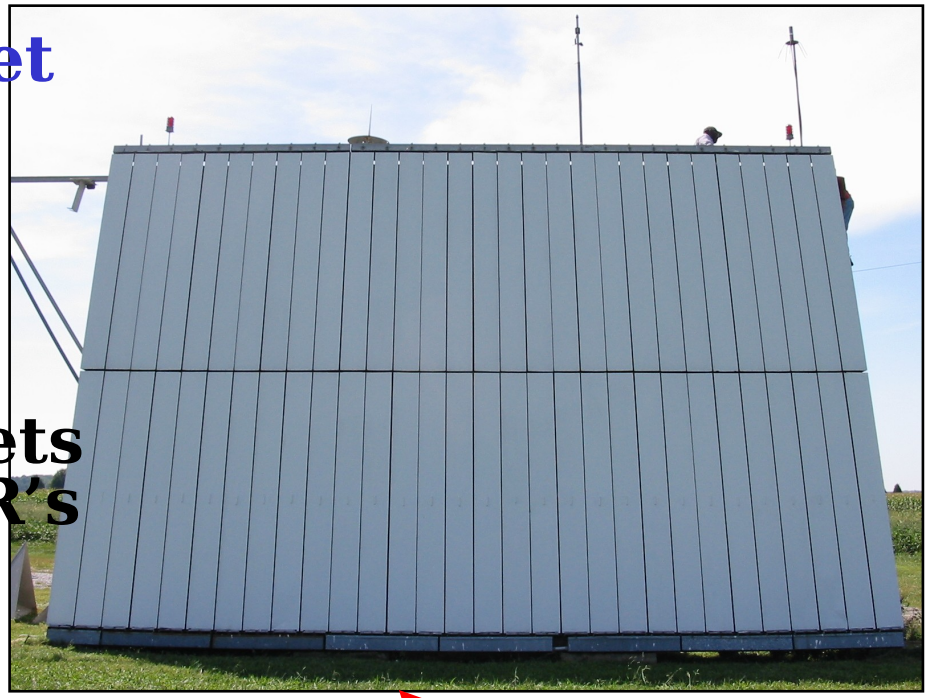
- **FLIR**
  - *SWIR*
  - *advanced focal plane arrays*
  - *increased resolution*
  - *scene projection*
- **Camera**
  - *increased resolution*
  - *enhanced low-light capability*
- **Laser**
  - *Laser λ other than 1.064μm & 1.57μm*
  - *verification of missile (PIM or octal) codes*
- **Other Systems**
  - *IR jammers and countermeasures*
  - *MWS and LWS receivers*

EOTT

Electro-Optical Test Target

- 2 rows of 30 panels
- panel = 1’ x 10’
- 20’ x 30’ heated area

- 3 grayscale shades
- canvas contrast targets
- lower resolution FLIR’s



EOTT – no targets

EOTT – 6 grayscale ste

IMISTS

Improved
Mobile
Infrared
Signature
Target
System

- 10’ x 10’ heated target
- 16x16 pixels (7.5” x 7.5
- high resolution FLIR’s

- laser targeting board
- LATS

Conclusions

T&E vital to Systems Engineering & Development Process:

- *validates system performance criteria*
- *improves system integration*
- *enhances performance through directed testing*
- *deals effectively with "cumulative system degradation"*

T&E helps provide better products to the w

Questions

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